

Limewater and Carbon Dioxide



Introduction

Limewater is a saturated solution of calcium hydroxide. When carbon dioxide is bubbled through limewater, a precipitate forms.

Concepts

- Gas solubility
- Acid–base

Materials

Bromthymol blue indicator solution, 0.04% aqueous (optional)

Calcium hydroxide solution, saturated $\text{Ca}(\text{OH})_2$, 400 mL

Beakers, 400- or 500-mL, 2

Drinking straws

Dry ice or a cylinder of carbon dioxide gas (optional)

Safety Precautions

Calcium hydroxide is a skin irritant. Avoid dust inhalation. The solution is a weak base. Avoid ingestion of the limewater solution. Dry ice must be handled with gloves or a towel. It will cause frostbite on unprotected skin. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Prepare a saturated limewater solution by boiling 2 L of distilled water, cover, and allow to cool overnight. Add 3.5 g of calcium hydroxide. Shake well and allow to settle. If the solution is cloudy at the time of use, filter.
2. Approximately 6 L of carbon dioxide gas may be produced by adding 6 M of hydrochloric acid to 25 g of calcium carbonate.

Procedure

1. Place 200 mL of clear limewater in two separate beakers.
2. In one beaker, bubble CO_2 and in the other gently blow through a straw and into the solution. Be cautious not to inhale and suck the limewater into the mouth. A calcium carbonate precipitate (CaCO_3) will soon form in both beakers. As carbon dioxide continues to be blown through both beakers, notice that the precipitate will dissolve in the beaker into which pure CO_2 is being bubbled because of the formation of a soluble calcium bicarbonate, $\text{Ca}(\text{HCO}_3)_2$. The concentration of carbon dioxide in the other beaker (into which you exhaled) is too low to bring about the formation of the calcium bicarbonate.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The resulting solutions should be disposed of according to Flinn suggested disposal method #26b. Dry ice can be evaporated in a well-ventilated area.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter, motions and forces

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure and properties of matter, motions and forces

Tips and Extensions

- This demonstration may be enhanced by adding a few drops of bromthymol blue solution to either or both beakers before beginning the demonstration. The pH range of the bromthymol blue indicator is 6.0–7.6 with the color change of yellow (pH 6.0 and below) to blue (pH 7.6 and higher). The pH of limewater is 12.4 so the solution is initially blue. As the precipitate forms, the indicator will change from blue to yellow, indicating the acidity of carbonic acid that is formed upon the addition of carbon dioxide.
- Limewater can be used in labs to prove the generation of carbon dioxide. An example of this is in the combustion of sodium bicarbonate. The students prove that carbon dioxide is a product by bubbling the gases produced through a solution of limewater.

Discussion

This demonstration shows that the solubility of a gas is dependent on its partial pressure. The partial pressure of carbon dioxide in exhaled air is much lower than would be necessary to dissolve the calcium carbonate. As seen in this demonstration, the partial pressure of the pure CO₂ is sufficient to dissolve the calcium carbonate (see Equation 2).

The reactions are rather simple:



Reference

Shakhashiri, Bassam Z., *Chemical Demonstrations, A Handbook for Teachers of Chemistry*, Vol. I, University of Wisconsin Press, Madison, pp 329–337.

Materials for *Limewater and Carbon Dioxide* are available from Flinn Scientific, Inc.

Catalog No.	Description
L0021	Limewater Solution, 500 mL
L0022	Limewater Solution, 4 L
B0047	Bromthymol Blue Indicator Solution, 0.04%, 500 mL

Consult the [Flinn Scientific website](#) for current prices.